Injuries in Professional Australian Soccer;

a League-Based Analysis of Injury Trends, Influences and Infrastructure.

By

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Certificate of Authorship and Originality of Thesis

I, Donna Lu, declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Abbreviations Symbols and Subunits

Symbol/Abbreviations	Word/Phrase
A-League	Australian League
FFA	Football Federation Australia
AFC	Asian Football Confederation
FIFA	Fédération Internationale de Football Association
UEFA	Union of European Football Associations
CONACACAF	Confederation of North, Central America and Caribbean Association Football
CONMEBOL	South American Football Confederation
CAF	Confederation of African Football
OFC	Oceania
F-MARC	FIFA Medical and Research Centre
PFA	Professional Footballers Australia
CBA	Collective Bargaining Agreement
MMS	Minimum Medical Standards
OSICS	Orchard Sports Injury Classification System
SMDCS	Sports Medicine Diagnostic Coding System
GPS	Global Positioning System
GLM	General Linear Model
GLMM	Generalised Linear Mixed Model
RR	Rate Ratio
ICC	Intraclass Correlation
CV	Coefficient of Variation
CI	Confidence Interval
h	Hour/s
=	Equals
≈	Approximately equal
+	plus
±	Plus or minus
%	Percent
α	Alpha
β	Beta
χ^2	Chi-Squared

Publications Resulting From this Thesis

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In review

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Lu, D., McCall, A., Jones, M., & Duffield, R. Variability of team-level injury underlying league-level injury rates in a professional soccer league. *Currently reviewed by the Legal Department of Football Federation Australia*

Lu, D., McCall, A., Jones, M., Steinweg, J., Gelis, L. & Duffield, R. The provision and infrastructure of medical care in professional Australian Professional Soccer Clubs. *Currently reviewed by the Legal Department of Football Federation Australia.*

Abstract

This thesis examines injury epidemiology, the impact of those injuries and the context of the injury epidemiology in the Australian professional soccer (association football) league (the A-League). To do this, data on injury, player-salary, team performance and provision and infrastructure of athlete care were collected from all A-League teams between seasons 2012/13 to 2017/18. The event of an injury and the characteristics were collected via a standardised injury surveillance system. For Study 1, the injury data was aggregated as a league and then by injury characteristics i.e. setting, mechanism, type and location. Generalised linear models (GLM) were used to model the data against seasons to report injury incidence rates (per 27 rounds) and trends over time. For Study 2, the injury data was aggregated by teams, and generalised linear mixed models (GLMM) were used to model the data against seasons to report injury incidence rates (per 27 rounds) and trends. Further, this analysis considered variations in team injury rates within a season and differences between teams across multiple seasons. For Study 3, the injury data was paired with player-salary and team performance costs of injury which were collated from confidential and publicly available data. Again, a GLM was used to analyse the trend of player-salary cost of A-League injuries and whilst a GLMM was used to assess the association between injury and team performance variables. For Study 4, the injury data was contextualised through a survey study where the head physiotherapist of each A-League team was asked to outline the provision and infrastructure of athlete care within the A-League.

The key findings from these studies were:

Study 1:

- The league-level (A-League) injury incidence rate ranged from 4.8 (95%CI:4.1–5.8) to 6.7 (95%CI:5.8–7.8) injuries per round per season and there were no significant differences between season 2012/13 to 2017/18 ($p<0.05$).
- Thigh injuries (23–36%), particularly hamstring injuries (54%–65%), were most common, with muscle/tendon injures the most common type (50–60% of total injuries/season). There were no significant differences between seasons within each injury type or location ($p>0.05$ and $p>0.05$, respectively).
- Regarding the setting of which injuries occur, training injuries decreased across the 6 seasons (exp(β) 0.59[95%CI:0.36–1.0]; $p = 0.04$).
- Although there was a higher proportion of non-contact injuries, both contact and non-contact injuries were not significantly different across the 6 seasons ($p > 0.05$).
- Mild severity injuries decreased (exp(β) 0.64 [95%CI:0.4–0.9];$p = 0.02$), whilst moderate severity injuries increased (exp(β)1.7 [95%CI:1.0–2.8];$p = 0.04$) in season 2017/18 compared to 2012/13. Severe injuries remained stable across the 6 seasons ($p>0.05$).

Study 2:

- Low variance (mean ± standard deviation = 34.1%±21.7) and poor to moderate reliability of between-season injury rate (ICC=0.319-0.831) supports the consistent stable injury trends at the league- and team-level injury rate.
- Team-level injury incidence rate ranged from 12.1 (10.1-14.5) to 18.2 (15.7-21.0) injuries per team per season, which significantly decreased in 2015/16 compared to 2012/13 ($p=0.011$).
- Joint/ligament injury rates significantly reduced in 2015/16 ($p=0.001$), which coincides with the significant reduction of injuries in the overall team-level injury rate. The model variance showed the reduction of Joint/ligament injuries was league-wide ($R^2m=0.23$; $R^2c=0.23$).

Study 3:

- Total league missed matches were significantly higher in season 2013/14 (55.1[50.7-59.9]; $p<0.01$) and 2014/15 (71.4 [66.4-76.8]; $p<0.001$) compared to 2012/13, without differences between other seasons. The significantly higher missed matches in 2014/15 were concomitant to the peak of player-salary cost which ranged between AUD $187,990 – AUD $332,680/team ($p<0.01$).
- Higher injuries rates were associated with additional goals conceded ($p=0.007$). Similarly, sum of missed matches was associated with more conceded goals and drawn matches ($p<0.000$).

Study 4:

- There were typically 1.6-1.9 physiotherapist per team tenured for 3.1±2.4 years and were postgraduate qualified (55-70%) with experience from other sports (70-91%). Additionally, there were 1.1-1.4 physicians, 1.1-1.3 massage therapists and 1.2-2.0 Exercise specialists each season ($p>0.05$).
- The Time Demands of practitioners did not differ between seasons ($p>0.05$), except for Exercise Specialists who increased by ≈30 h/week in 2015/16 compared to season 2010/11 ($p=0.014$).
- The provision of injury prevention programs was delivered daily as a whole squad over the 4 seasons ($p>0.05$). However, an increase in subgroup injury prevention on either a daily or several times/week existed ($\chi^2=0.041$;$p=0.005$). All teams completed preseason musculoskeletal screening in all seasons.

In summary, muscle/tendon injuries at the thigh, particularly at the hamstring, are of interest for stakeholders when developing or allocating resources to injury prevention. Competition organisers and medical staff should still be aware of the variation in less common injuries, though individual injury trend analysis should address such an issue. Key findings suggest interpretation of stable league- and team-level aggregated injury rates is accurate, which is supported by the low between-season injury rate variance. Nonetheless, injury prevention programs need to continue to focus on muscle/tendon and joint/ligament injuries at the hamstring and knee.

The league-wide reduction in injury rate in 2015/16 was mirrored by a trend for reduced joint/ligament injuries. The observed reduction was league-wide rather than a single team or a group of teams, suggesting most teams had exposure to the cause of the injury reduction. Although currently speculative, league-wide injury prevention strategy, such as a league-wide physical exercise programs, education and/or policy, may be plausible explanations. Such strategies require all levels of stakeholders (i.e. Competition organiser, clubs/ team officials and players) to be involved. Of interest to competition organisers and coaches, injury and missed matches are associated with goals conceded and matches drawn, though the magnitude of the association is small.

Finally, the findings suggest that injuries are relatively stable, and infrastructure of athlete care was similar despite more recent emphasis on injury prevention in the A-League between seasons 2012/13 to 2017/18. Competition organisers and clubs should be aware that having adequate provision and infrastructure of athlete care within teams may enable better control of injury rates. However, further reductions of injury require targeted injury prevention programs to the team and the individual player.